

CLAIMS

1. A humidifying device for humidifying a gas, with the water vapor contained in air, comprising:

5 a hollow fiber bundle formed by bundling a plurality of hollow fibers permeable by water vapor, the hollow fibers being orientated in a direction of a predetermined axis;

10 a housing having a space for accommodating the hollow fiber bundle therein, and having an introduction port for the gas to be humidified, communicating to bores of the hollow fibers, a discharging port for the gas to be humidified, communicating to the bores of the hollow fibers, an air inlet communicating to a space in the housing external of 15 the hollow fibers, and an air exit communicating to the space in the housing external of the hollow fibers; and

blowing means arranged at the air inlet of the housing for introducing air into the housing,

20 wherein a ratio between a sum of the cross-sectional areas of the hollow fibers taken along a plane perpendicular to the axis, and the cross-sectional area of an air passage, is set within a range from 0.1 to 0.7, the cross-sectional area of the air passage being obtained by subtracting the sum of the cross-sectional areas of the hollow fibers from the cross-sectional area 25 of the space of the housing taken along a plane perpendicular to the axis.

30 2. A humidifying device as defined by claim 1, wherein the ratio of the cross-sectional areas is set within a range from 0.2 to 0.6.

35 3. A humidifying device as defined by claim 1, wherein the hollow fiber is comprised of a polyimide membrane or a polyether-imide membrane.

4. A humidifying device as defined by claim 1, further comprising:

a humidity sensor provided at the discharging port for detecting the humidity of the gas to

be humidified; and

5 a control section for controlling the blowing means to make the humidity of the gas to be humidified, as detected by the humidity sensor, equal to a predetermined value.

5. A humidifying device as defined by claim 1, wherein the gas to be humidified is an oxygen-concentrated gas.

10 6. An oxygen concentrating system, the system adsorbing nitrogen contained in the air and removing it therefrom to produce an oxygen-concentrated gas for a medical use, and comprising:

15 an oxygen concentrating section of a pressure-swing adsorption type having a plurality of adsorption columns, the columns respectively accommodating adsorbents having a selective absorbability for nitrogen;

20 a conduit for introducing the oxygen-concentrated gas produced in the oxygen concentrating section to a user;

pressure-adjustment means disposed in the conduit for adjusting a pressure at an exit of the oxygen concentrating section to a constant value;

25 flow rate regulating means for regulating a flow rate of the oxygen-concentrated gas flowing through the conduit to a constant value; and

the humidifying device as defined by claim 1.

7. A humidifying device for humidifying a gas, 30 with the water vapor contained in air, comprising:

a plurality of hollow fiber bundles respectively formed by bundling a plurality of hollow fibers permeable by water vapor, the hollow fibers being orientated in a direction of a predetermined axis;

35 a housing having a space for accommodating the plurality of hollow fiber bundles, and having an introduction port for the gas to be humidified,

5 communicating to bores of the hollow fibers of the respective hollow fiber bundles, a discharging port for the gas to be humidified, communicating to bores of the hollow fibers of the respective hollow fiber bundles, an air inlet communicating to an space in the housing external of the hollow fibers, and an air exit communicating to the space in the housing external of the hollow fibers; and

10 blowing means arranged at the air inlet of the housing for introducing air into the housing.

8. A humidifying device as defined by claim 7, wherein the hollow fiber is comprised of a polyimide membrane or a polyether-imide membrane.

15 9. A humidifying device as defined by claim 7, wherein each of the hollow fiber bundles includes 50 to 1,000 of hollow fibers.

10. A humidifying device as defined by claim 7, further comprising:

20 a humidity sensor provided at the discharging port for detecting the humidity of the gas to be humidified; and

25 a control section for controlling the blowing means to make the humidity of the gas to be humidified, detected by the humidity sensor, equal to a predetermined value.

11. A humidifying device as defined by claim 7, wherein the gas to be humidified is an oxygen-concentrated gas.

30 12. An oxygen concentrating system for a medical use, the system adsorbing nitrogen contained in the air and removing it therefrom to produce an oxygen-concentrated gas for a medical use, and comprising:

35 an oxygen concentrating section of a pressure-swing adsorption type having a plurality of adsorption columns, the columns respectively accommodating adsorbents having a selective absorbability for nitrogen;

a conduit for introducing the oxygen-concentrated gas produced in the oxygen concentrating section to a user,

5 pressure-adjustment means disposed in the conduit for adjusting a pressure at an exit of the oxygen concentrating section to a constant value,

10 flow rate regulating means for regulating a flow rate of the oxygen-concentrated gas flowing through the conduit to a constant value; and

the humidifying device as defined by claim 7.